RENEWABLE ENERGY INTEGRATION STUDY IN ISLANDS

THE CASE OF THE ISLAND OF VITI LEVU - REPUBLIC OF THE FIJI ISLANDS

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Agenda

- Grid Integration work at IRENA Innovation and Technology Centre
- IRENA Grid Integration Assistance to Islands
  - Grid Integration study for Viti Levu, Fiji
  - Grid Integration study for Espiritu Santo, Vanuatu
- Closing Remarks

Grid Integration - Overview

TECHNICAL ASSISTANCE

Grid Studies of Power Systems with High share of VRE

Power Flow Analysis, Frequency Stability Analysis, Contingency Analysis, and Transient Stability Analysis

E.g.: Grid Integration of Loganville, Vanuatu (2019)

Grid Operation and Management with High share of VRE

Power Flow Management, Grid Assets Outages Management, Automatic Generation Control, Demand Side Response, and Technology/Economic-Based Generation Dispatch.

E.g.: Capacity building for grid operator in the Clean Energy Corridor for Central America CECCA (2018)

Power System Engineering

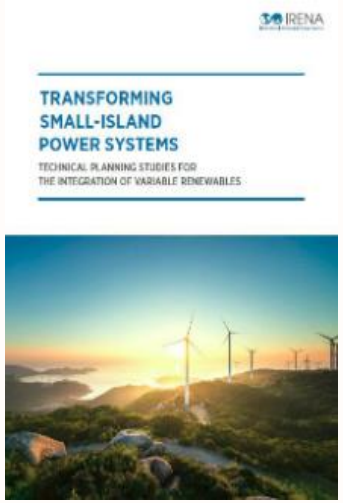
Protection Systems for VRE, Power Engineering Software, Installation and Maintenance of Grid Assets, Grid Codes

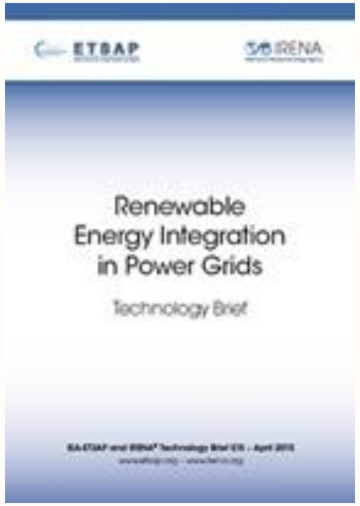
E.g.: Publication "*Transforming Small-Island Power Systems – Technical Planning Studies for the Integration of Variable Renewables*" (2018)

CAPACITY BUILDING

ADVISORY SERVICES

PUBLICATIONS





SUPPORTING TOOLS

PowerFactory – DIgSILENT

PSSE – Power System Simulator for Engineering

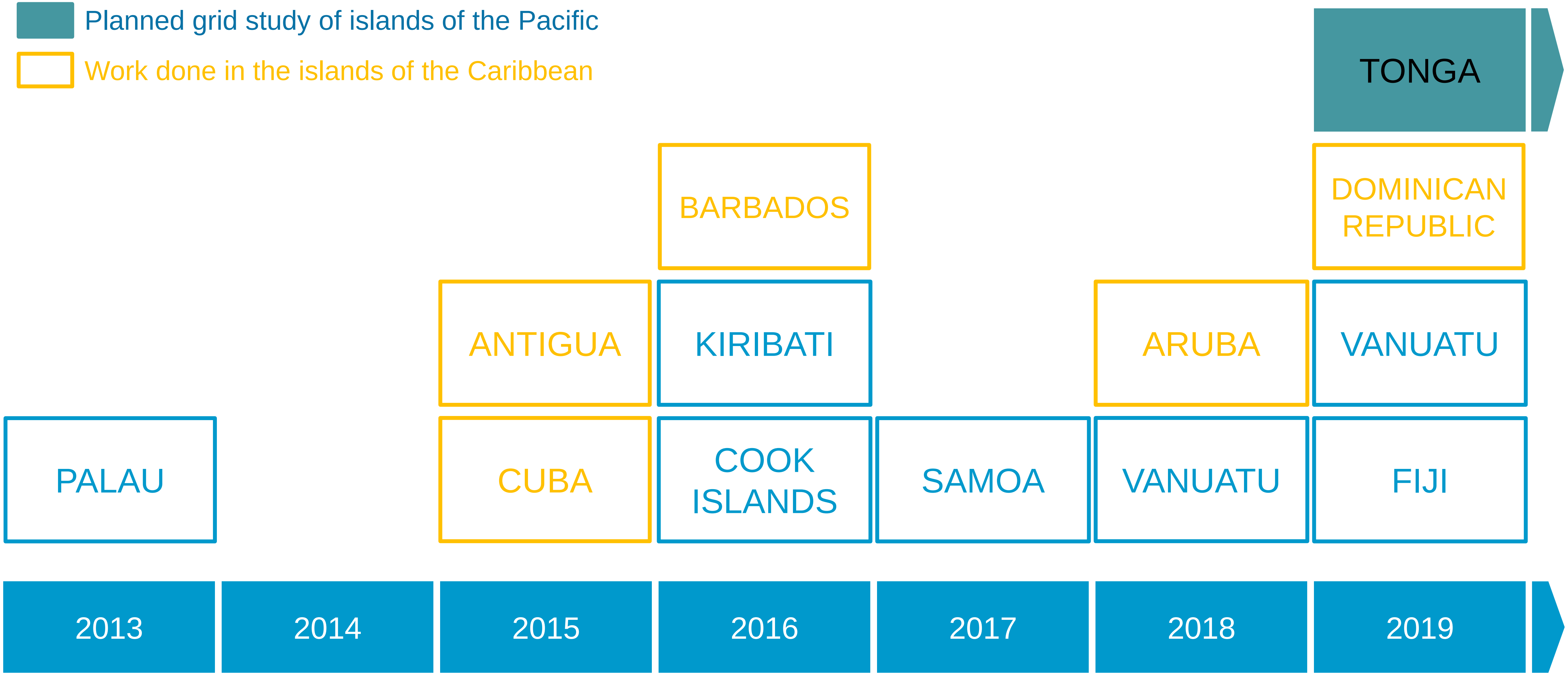
IRENA Grid Integration Assistance to Islands

IRENA International Renewable Energy Agency

Work done in the islands of the Pacific

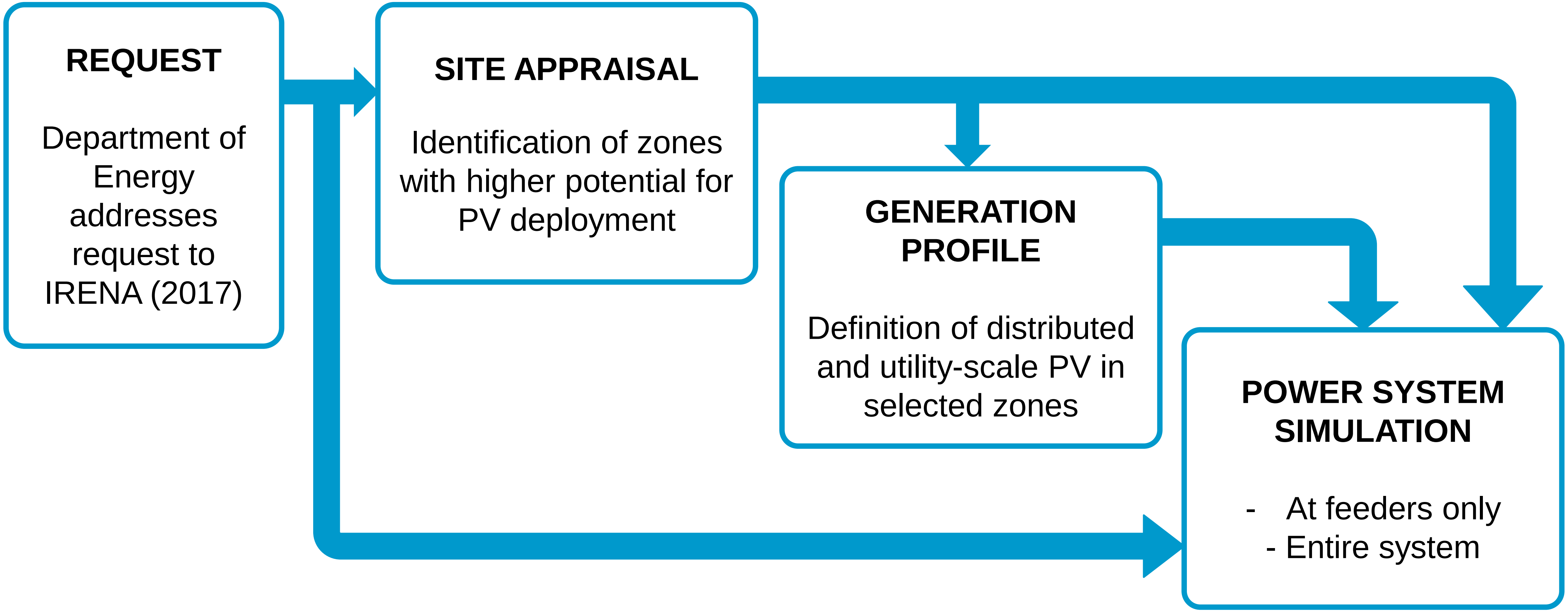
Planned grid study of islands of the Pacific

Work done in the islands of the Caribbean



Grid Integration study for Viti Levu, Fiji

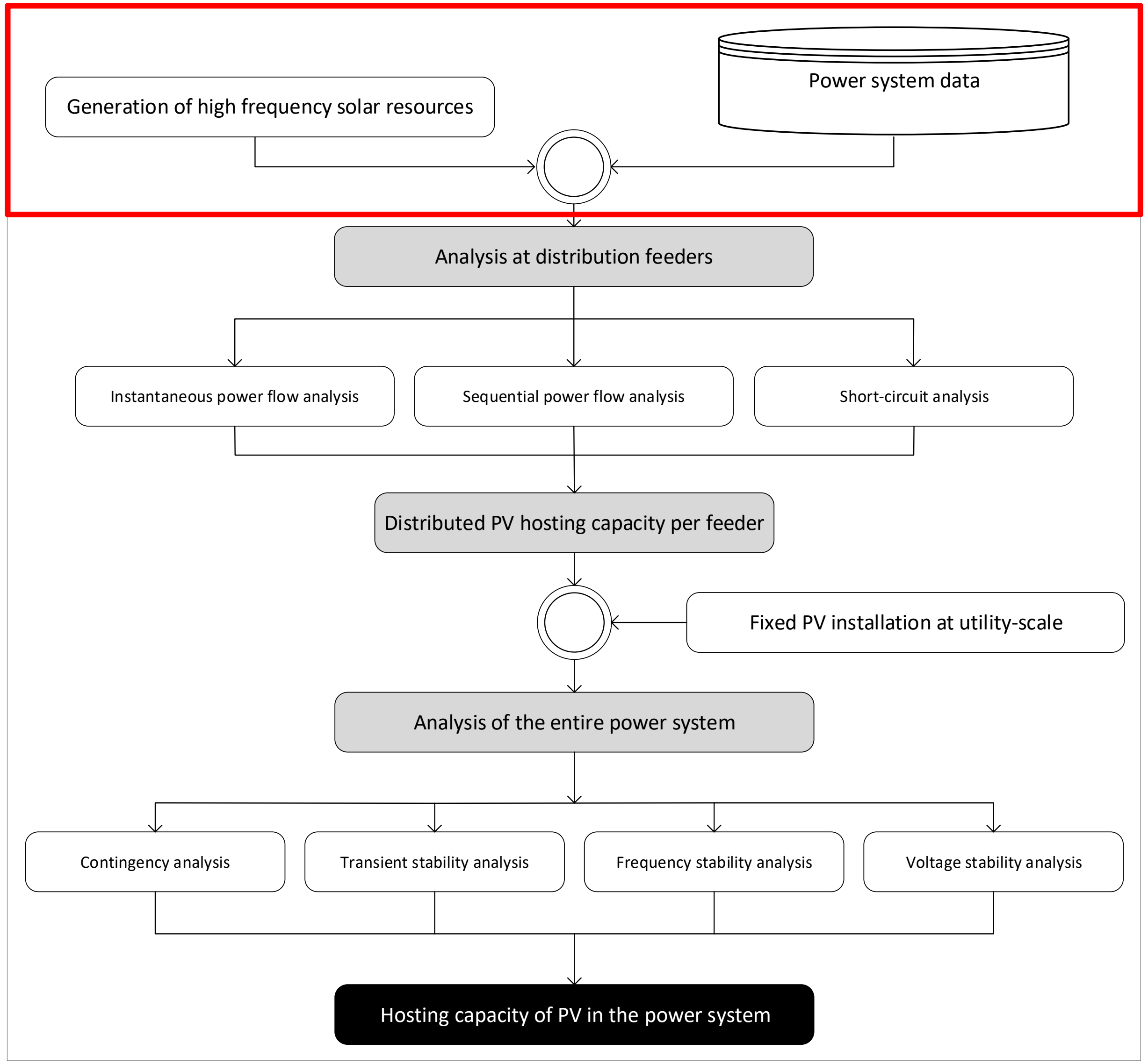
The project



Grid Integration study for Viti Levu, Fiji

METHODOLOGY (1)

- Generation of High Frequency Solar Resources:
  - Obtained from AWS Truepower LLC
- Data of the Power System:
  - Provided by EFL
- Power System Modelling
  - Developed by IRENA and The University of Comillas (Spain)

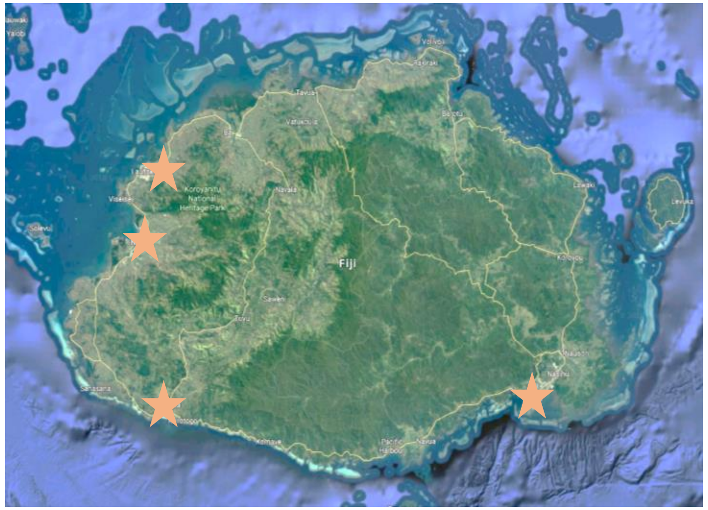


Grid Integration study for Viti Levu, Fiji

METHODOLOGY (2a)

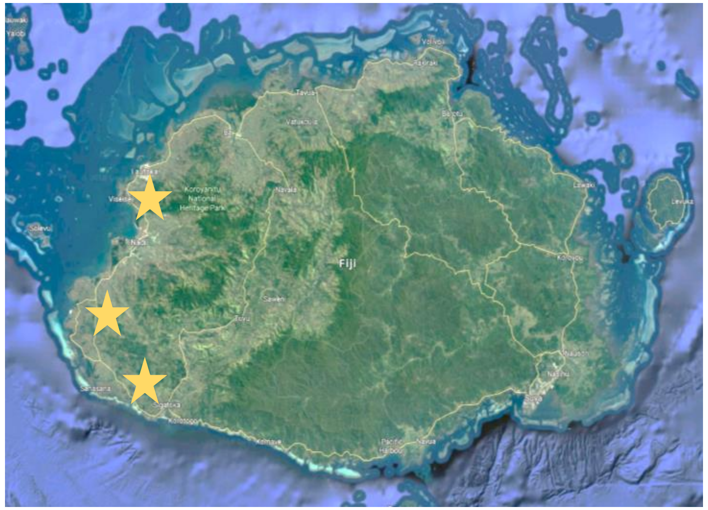
Distributed PV areas of Interest (4 Sites)

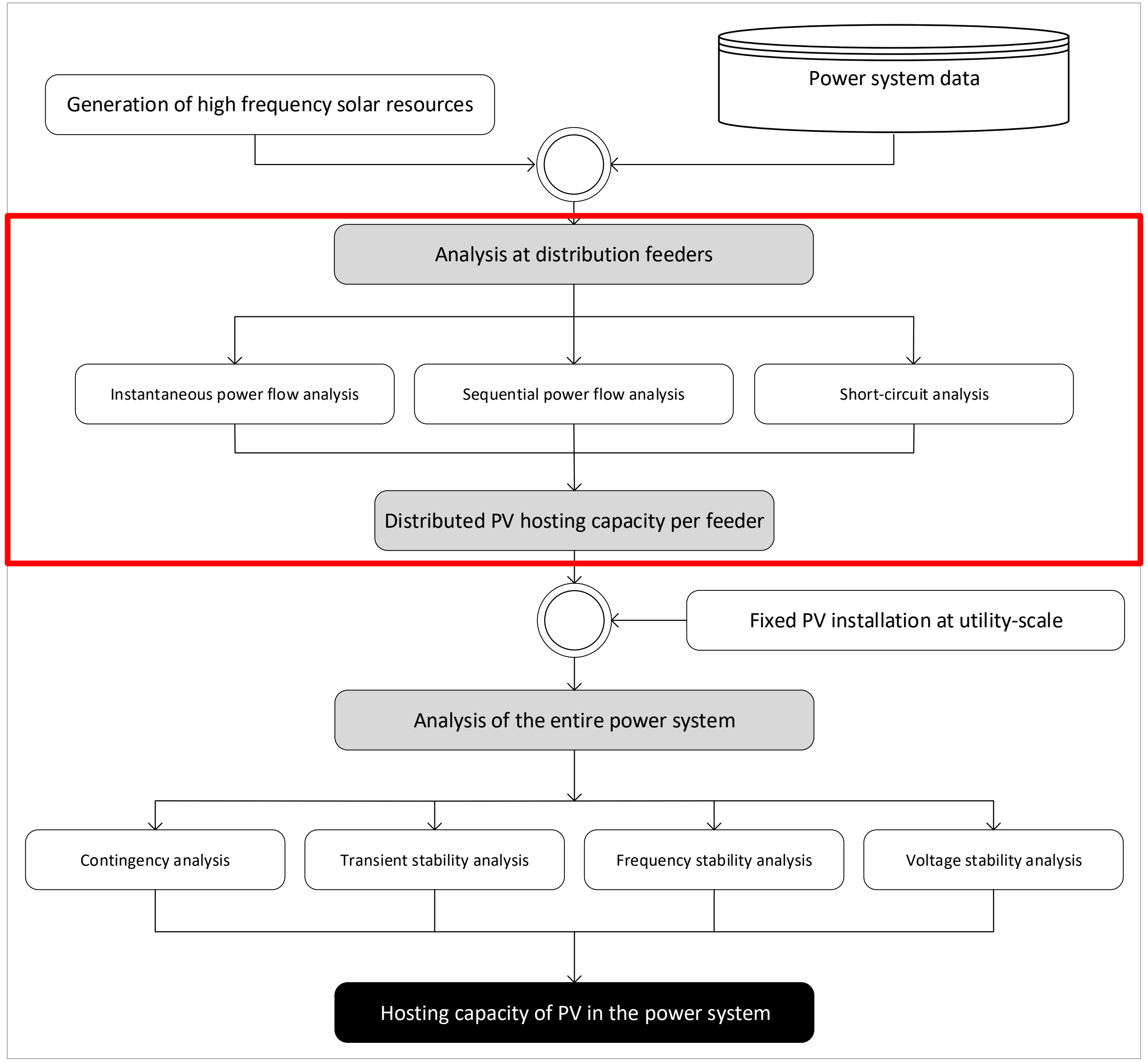
Nadi
Sigatoka
Suva
Lautoka



Utility-Scale PV Sites (3 Sites)

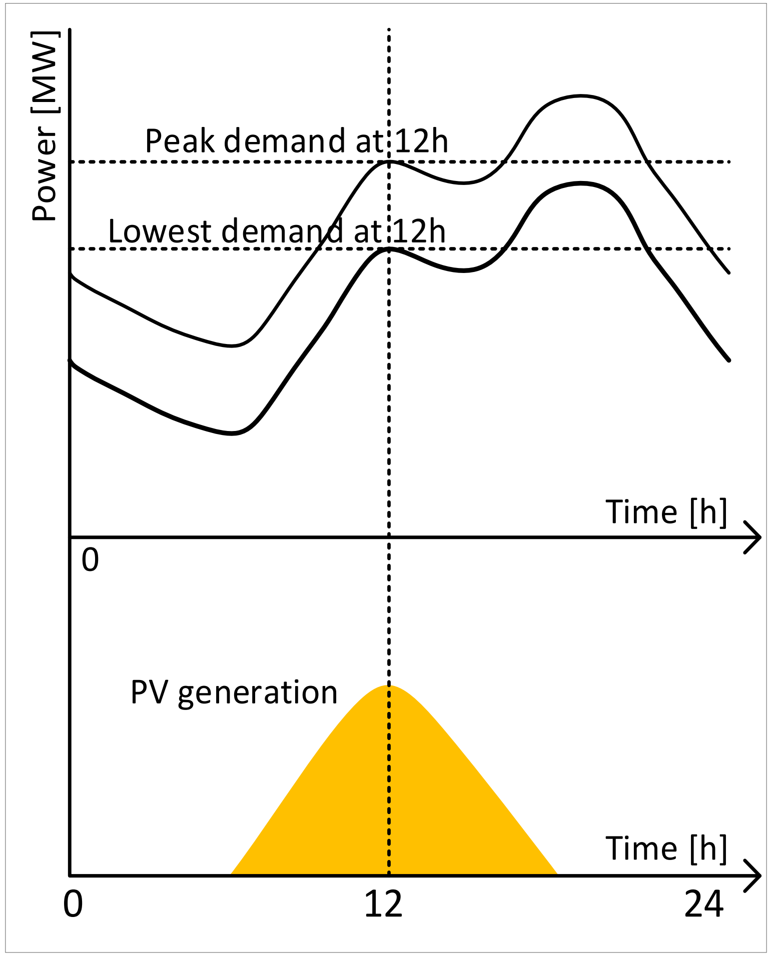
Nalovo/Navutu
Nabau/Voua/Sigatoka
Vuda/Lautoka

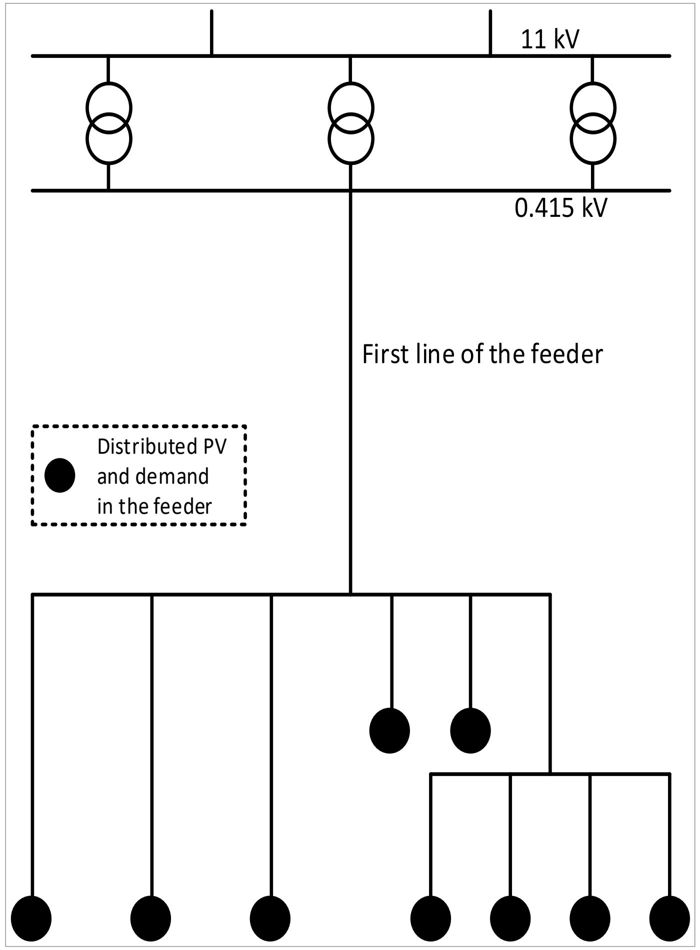


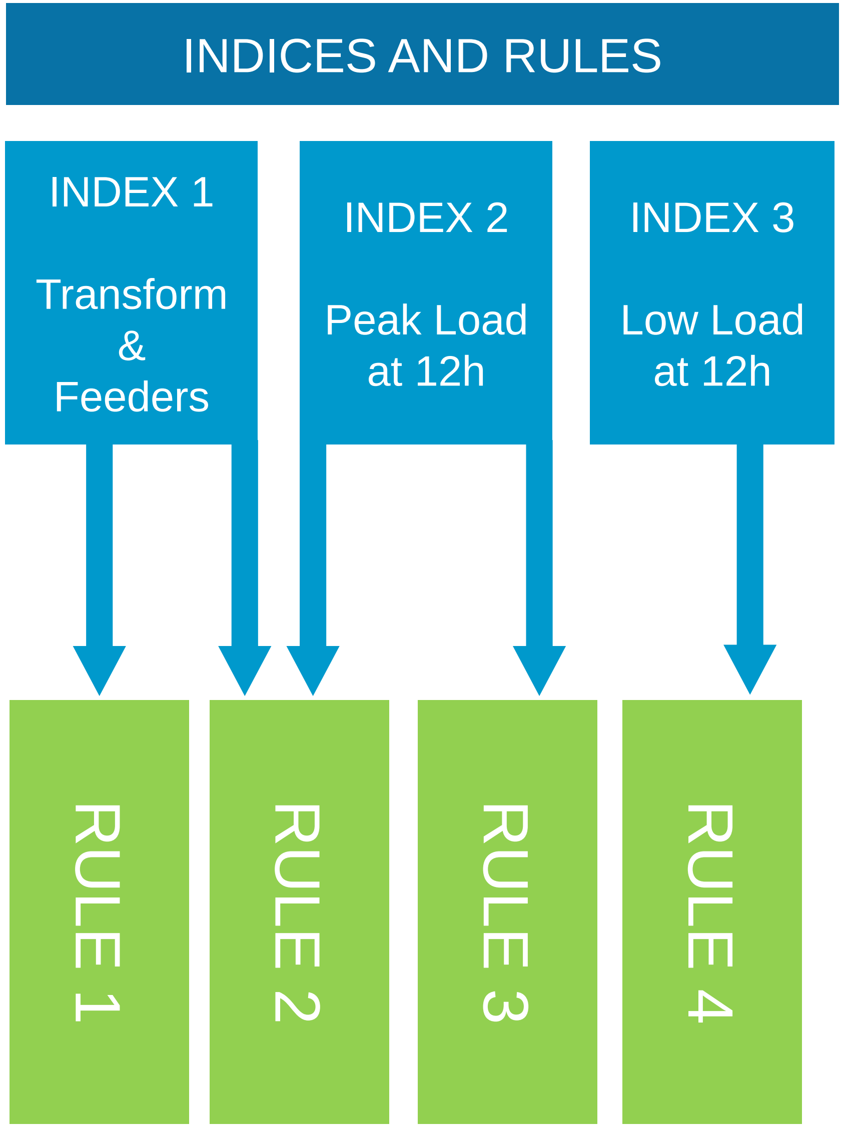


Grid Integration study for Viti Levu, Fiji

METHODOLOGY (2b)



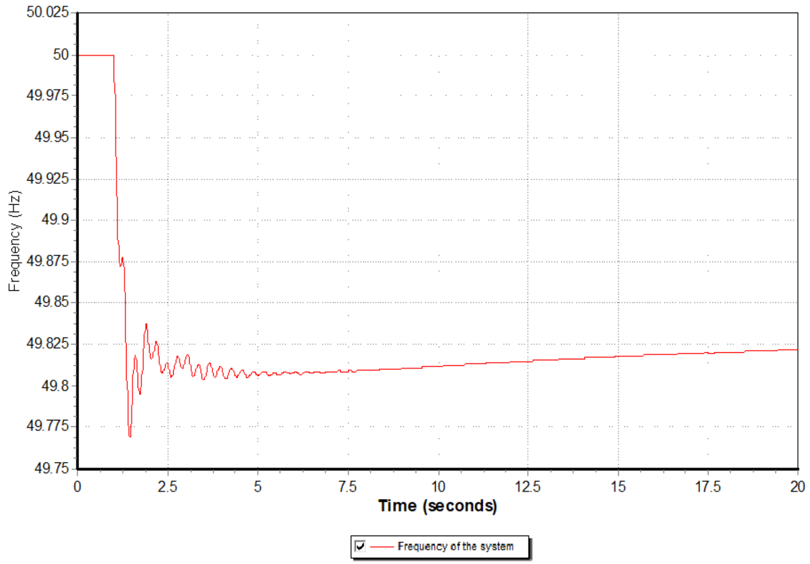


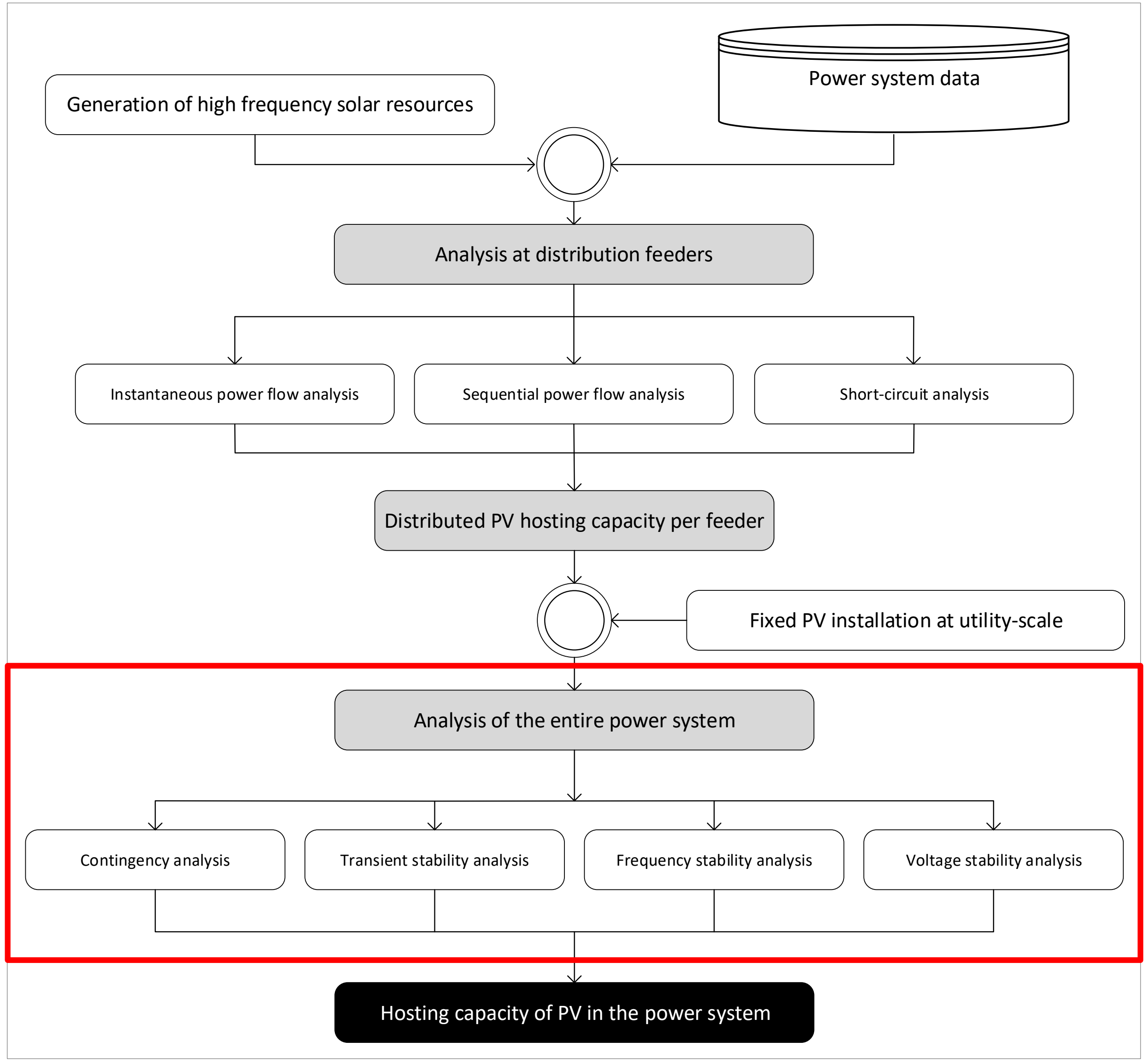


Grid Integration study for Viti Levu, Fiji

METHODOLOGY (3)

- Consider the results of the maximum hosting capacity defined at feeders' level together with the 25 MW fixed at utility-scale level.
- Assess and identify system constraints
- Adjust the Distributed PV values at feeders
- Define the level that assures system stability





Grid Integration study for Viti Levu, Fiji

CONCLUSIONS

- The methodology used in this study is consistent and can be applied in studies of other islands.
- The utility can define the rule of the methodology, from very ambitious to very conservative.
- It was concluded that the maximum DPV hosting capacity using Fiji's grid code can vary between **6.2% and 25%** of the peak yearly demand verified at 12h00 in 2017.
- For instance, if the grid code of Australia is implemented, the maximum DPV hosting capacity in the Viti Levu power system is **41%** of the peak yearly demand verified at 12h00 in 2017.

Grid Integration study for Espiritu Santo, Vanuatu

The project

REQUEST

Department of Energy addresses request to IRENA (2017)

SYSTEM EXTENSION

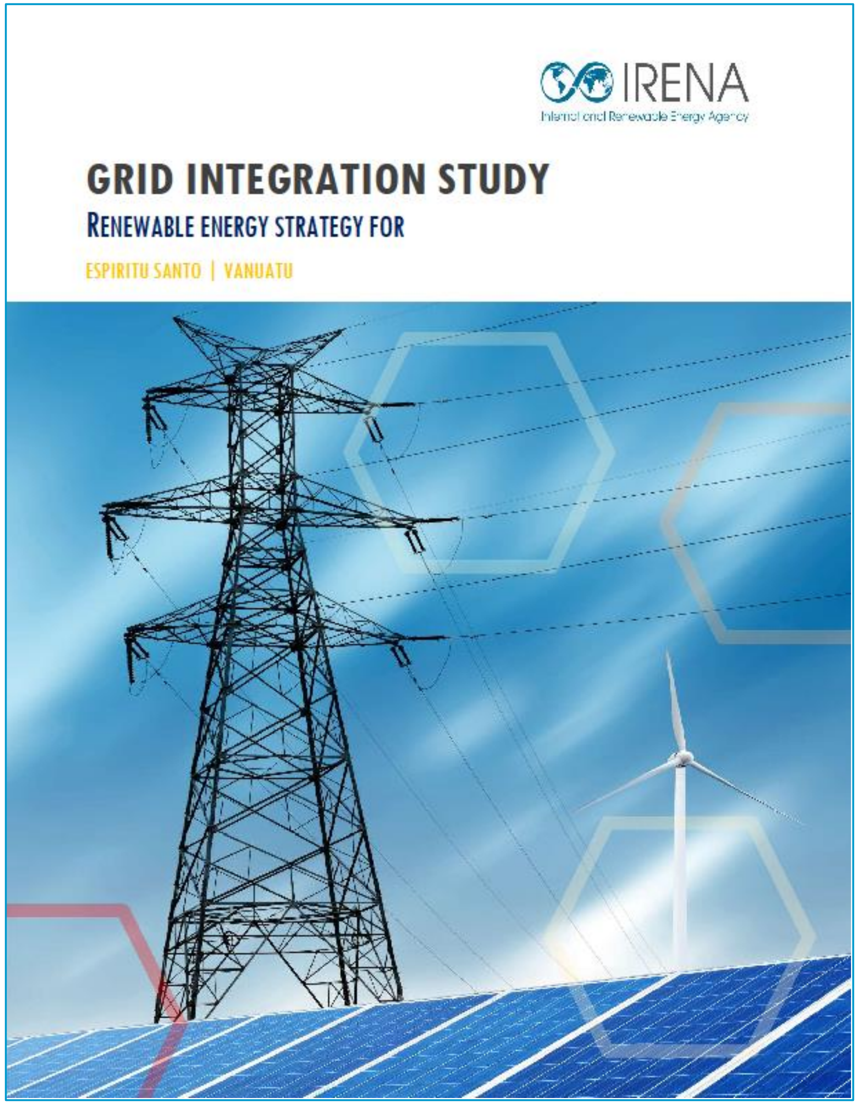
- Hydropower options
- PV deployment
- Grid extension to Port Olry
- 2.2% to 4.4% Load Growth (2018 to 2030)

DEFINITION OF SCENARIOS

- Base case
- Lowest long-term cost
- Highest share of renewables
- Lowest implementation of enabling technology

GRID STABILITY ANALYSIS

- Steady-state
- Frequency stability
- Contingency n-1
- Transient stability



Grid Integration study for Espiritu Santo, Vanuatu

CONCLUSIONS

- The following had influence on defining the best options for the island:
  - No possibility for the hydro system to retain water (energy storage) due to terrain relief.
  - Lower gradient of the hydropower generators.
  - Distance from the hydropower to the main demand area.
- The best outcome for system configuration, based on above constraints and 25-year net present cost if compared to the base case, was obtained from grant funded 800 kW and 300 kW of new hydropower, 2 MW of solar PV, enabling technologies and a comprehensive hybrid control system.
- The above best option allows the island to achieve **87% of renewable energy share in 2030**.

Closing Remarks

- IRENA grid integration works closely with Member Countries to facilitate technical assessment for the integration of different renewable energy technologies onto their power systems, under the SIDS Lighthouses Initiative.
  - Support islands in improving the stability of their current power systems
  - Provide technical advise based on the assessment of requirements in the power system to integrate higher share of renewables.
- SIDS benefit with IRENA grid integration studies include:
  - Get insight on the potential of renewable energy in the State
  - Be advised on the required technical measures to integrate VRE
  - Obtain technical advise that can facilitate changes of energy policy, like grid codes, toward power system transformation.

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Thank you

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